

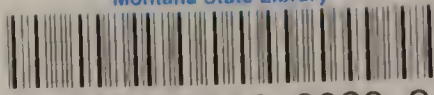
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Educational Technology in Montana Schools



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**Educational
Technology
in
Montana Schools**

A Framework For Thought

**June 1995
2nd Printing**

**1994 Educational Technology
Advisory Committee**

and

**Nancy Keenan
State Superintendent of Public Instruction**

**Beth E. Satre
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The Office of Public Instruction

Nancy Keenan
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Dear Educators, Administrators, Parents and Community Friends of Education,

This monograph is one in a series of papers that focus on contemporary issues in Montana schools. It is our hope that the research and resources contained here will build awareness and identify skills that will be helpful to you in addressing some of the most pressing and relevant topics confronting our students and staff today.

The information is designed to clarify key problems, identify strategies to affirm students, and provide school personnel with knowledge and information to make good decisions. Many of these contemporary issues involve difficult barriers (both subtle and overt) to educational equity guaranteed by the Montana Constitution.

This series is designed to present in a brief and concise format the newest research, ideas, and successful practices of educators across the nation. We are sensitive to your need for current information as you are faced with critical decisions involving curriculum, educational equity, and the demands and concerns of your community members. Resources, research and technical assistance on successful practices will be included in each monograph.

One of my priorities is to assist educators, administrators and community members in solving contemporary problems in education so that our students receive the best preparation we can give them for full and productive lives. I sincerely hope these monograph issues will be a strong contribution to our joint efforts to put Montana's children and youth first. Your reactions and responses to this monograph series are welcomed.

Sincerely,

Nancy Keenan

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Introduction

In July 1994, Governor Marc Racicot and State Superintendent Nancy Keenan decided to apply for funding under Public Law 103-227 (Goals 2000: Educate America Act). In addition to supporting grants for local school districts, the federal monies would finance a state improvement panel and a technology task force. These groups would be charged with developing a state education improvement plan. Titled "The Montana Plan: Making Good Schools Better," Montana's application was approved in November 1994, and the panel and task force were appointed by the governor and superintendent in December 1994.

In August of 1994, while the application to the U.S. Department of Education was being approved and the groups were being appointed, State Superintendent Nancy Keenan convened a technology advisory committee to provide assistance to the soon-to-be-appointed technology task force. Recognizing the need to glean information from those who have firsthand experience with technology and its application in the classroom, Keenan selected teachers, principals, superintendents, and technology coordinators from around Montana to serve on the advisory committee.

Their professional experiences have convinced those appointed to the technology advisory committee that the proper use of technology can only enhance both teaching and learning experiences. Furthermore, advisory committee members determined that the integration of technology into the classroom is fast becoming a necessity. The advisory committee examined research, current practices and resources needed for the integration of technology in the teaching and learning process.

This monograph contains background information gathered by State Superintendent Nancy Keenan's Education Technology Advisory Committee and the Office of Public Instruction. The materials were compiled for the Montana Plan Educational Technology Task Force to assist them in their deliberations as they develop a systemic statewide technology plan for Montana public schools. It is also hoped these materials will provide other Montana educators with a framework for thought.

The purpose of this study was to explore the experiences of Montana educators in implementing educational technology in their classrooms. The study was conducted in a qualitative manner, using interviews and focus groups to gather data. The findings of the study suggest that educators face a variety of challenges in implementing educational technology, including a lack of resources, a lack of training, and a lack of support. However, educators also reported a number of benefits, including increased student engagement, improved student learning, and increased teacher effectiveness. The study also identified a number of factors that influence the successful implementation of educational technology, including the availability of resources, the quality of training, and the level of support.

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Educational Technology Visions

Technology Advisory Committee members researched and discussed various visions for the theoretical and practical use of technology in Montana's classrooms. What follows is a sampling of visions—including that vision formulated by the advisory committee, nine guiding principles for the most effective use of technology in schools, and five “vision scenarios” which illustrate technology's potential to enhance teaching and learning when it is correctly applied. The learning situations described in the scenarios currently exist in Montana, but are available to only a few students.

A Sampling of Visions...

“Emerging information technologies will affect the quality of life of America's children—today and in their future. When educational technologies are integrated into curricula, research shows that they not only provide students with technical skills but also enhance students' performance in the basics.

Education in our society is the responsibility of the whole community. Educational technologies are a means of ensuring equitable and universal access to opportunities for lifelong learning. Technology tools, skilled educators, and community members will prepare children to be productive citizens in an ever-changing world.”

— *Montana Educational Technology Advisory Committee*

“In a society increasingly dependent on information, a crucial component of education is equitable and universal access to technology and information resources.

With these tools and the guidance of skillful educators as well as community members, students take responsible roles in their own learning, and are actively engaged in creating learning environments as they think, solve problems and communicate in collaborative and interdisciplinary settings. Students emerge as lifelong learners, productive members of the workforce, and contributing citizens.”¹

—Washington Education Technology
Advisory Committee

“Every child is unique. Each has different interests, different abilities, and a different way of learning. Recognizing this kind of diversity, it is essential that teachers have flexible, adaptable tools that allow children to learn at their own pace, in their own way. Creating an interactive learning environment through the integration of technology with curriculum will enrich and empower each child toward becoming an independent and creative thinker and learner. Teachers must be given the means to stimulate curiosity, encourage exploration, and meet the individual needs of each student in preparation for the most important test of all: their future.”²

—Conrad, MT, Public Schools
Computer Curriculum

A Sampling of Visions, cont...

"Technology has the potential to serve as the catalyst for the educational change the public is seeking. To make that happen will require a broad view of issues, challenges, and opportunities and action by education, business and industry, government and the community at large.

That means that education must look beyond the immediate issues of schools and begin to collaborate more closely with stakeholders.... As electronic resources become available it is important that policy makers review and revise policies and procedures to reflect technology. These policy changes can increase students' learning options while maintaining high educational standards, ensuring equity of opportunity for all students, and protecting the rights of all citizens in this new technological arena."³

—1994 Washington State Education Technology Plan

"Technology Literacy will surely have a great influence on whether American children are competitive in the global economy of the Information Age. But there is as yet neither a national policy nor leadership defining how we will ensure that the 47 million elementary and secondary school students in the United States master this new literacy.

Schools cannot do the job alone. Americans should expect the best education possible from public schools, but what is needed in order to achieve this is an adequate commitment of resources along with the active and supportive involvement of the private sector, federal, state and local governments, and parents."⁴

—America's Children & The
Information Superhighway

"Our vision is one of a fully integrated cross-curricular technology system, developed through collaborative partnerships, that significantly impacts student learning."⁵

—Oregon Goals 2000 Technology Proposal

"The mission of the Bellevue Schools is to ensure that all students become successful, life-long learners. It is difficult to imagine that this goal could be obtained without preparing students for the information age of the 21st century. Both instructional practice and supporting curricular and management systems must take advantage of the power of current and emerging technologies."⁶

—Bellevue, WA, Public Schools
Technology Plan

The Vision: Guiding Principles

During the advisory committee's discussions of their experiences as educators in the classrooms, it became clear that the following nine points were important to consider in any deliberation concerning the educational application of technology in Montana schools.

1. A statewide information infrastructure should be created in Montana which would connect all K-12 classrooms, homes, businesses, and institutions of higher education.
2. The mission of schools should be refocused to include the integration of technology into the curriculum and classroom in order to emphasize not "knowledge dissemination" but problem solving and independent thinking. It is also important to involve and provide access for the entire community; schools should become a community resource.
3. A high priority should be placed on teacher training in the use of technology and its integration into the curriculum and classroom. Staff development is—and should be considered—crucial to the success of any technology plan.

"A true strategic plan...establishes the priorities and the particulars of universal reach, backed by the necessary financing to guarantee that every classroom, library, community center and home has adequate hardware, software and access to the superhighway. [It also has a] step-by-step plan and timetable for achieving it."⁷

—*America's Children & The Information Superhighway*

4. The use of technology in Montana schools should be approached in a well-planned, universal, equitable, and long-term manner.
 - All districts should have board-approved technology plans and a commitment to those plans.
 - Provision should be made to assist districts and schools in the development and implementation of their educational technology plans. Furthermore, those plans should be institutionalized.
 - **All** students should be provided access to whatever technology is implemented.
5. Financing should be considered in a well-planned and long-term manner. Ongoing support structures and procedures need to be established for purchasing, maintaining, and updating technology and staff.
6. Students should be taught to evaluate and manage the informational resources they can access.
7. Community commitment is a necessary component in this process. Implementing technology plans and establishing the necessary support structures call for the retooling of schools and the classroom.
8. A vehicle for assessing the use of technology and the technology plan needs to be established.
9. Pre-School through age 100, not just K-12 education, should be the goal. Communication and interaction among teachers, students, businesses, and community members should be facilitated.

The Vision: Guiding Principles, cont...

In the June 1994 draft of the Washington State Technology Plan for K-12 Schools, the following five principles are cited as forming the basis for the state plan:

1. In our rapidly changing world, the economic viability of communities and individuals depends on the ability to access information, build knowledge, and solve problems. Technology plays a key role in this process and students must develop skills in its use.
2. Now and in the future all learners and educators must have equitable and universal access to information and technology and be skilled in technology applications.
3. Communication linkages among all of the "stakeholders" in a child's life are critical to the education and well-being of the whole child. Technology is a critical element in establishing these vital linkages.

"We as a nation cannot afford even to contemplate *not* "plugging in" education to a national and international telecommunications infrastructure. To remain outside of that infrastructure is to deny students and teachers access to what will be the basic information resources of future society, thus robbing future generations of the tools and resources that they will need to be effective citizens, workers, thinkers and social beings." ⁸

—Professor Dennis D. Gooler, Chair
Dept. of Curriculum & Instruction,
Northern Illinois University

"Teachers who use technology for restructuring do not focus on the machinery of technology. They look instead at the opportunities technology offers for enhancing learning. They assume new roles as they move away from the traditional roles of presenter and knowledge provider to become collaborators, researchers, mentors, facilitators and long-range planners."

--Ned Levine, Principal, Willson Science & Technology School and Member, Edtech Advisory Committee

4. The use of technology is essential to the restructuring of schools through:
 - increased access to information;
 - increased application of appropriate instructional, management, and assessment tools;
 - new strategies and tools which involve students in creating and producing meaningful knowledge; and
 - greater relevance to the community and workplace.
5. Effective use of technology in schools in Washington State must be based on coordinated planning and funding efforts at the state, regional, and local levels. To effect change, factors such as training, support, and time must be addressed simultaneously.

The Vision: Scenarios - What's Possible

Kids, Computers, and History Kiosks

Ariana and Jeff are part of a team currently engaged in a two-year cooperative project with the U.S. Forest Service. The project goal? These eighth graders at Rattlesnake Middle School are developing an interactive display to be used in kiosks at ranger stations and visitor centers along the Nez Pierce National Historic Trail. After carefully researching the Nez Pierce Indians and their 1877 attempt to evade capture by the U.S. Army and escape through Montana into Canada, Jeff and Ariana's team used computers, videos, pictures, aerial films, maps, historical accounts and facts to produce a multi-media program on the subject. The students designed their program to include historical background on both the Nez Pierce, the U.S. Army, and the battles fought along the Nez Pierce Trail with special focus on locations between Lolo Pass and Stevensville. Viewers can see historical figures, listen to their words, and gain an overview of the area's geography. Currently, Jeff's and Ariana's team is preparing to incorporate touch screens into their final products. As early as next summer, their program could be up and running for the visiting public. Using today's technology, Ariana, Jeff, and their other teammates will give residents and visitors the chance to take a step back into the past and catch a glimpse of the historic drama which unfolded in the Bitterroot.

The Sky's the Limit

The 70 students at Rapelje School are "taking off" where technology is concerned — the entire school is immersed in rocketry and space travel. Students in Mr. Erfle's technology class designed and built model rockets, a launch pad, and a lego transport tram. They then developed a program to operate the tram by computer; programmed "Robie," a small robot, to remove the rocket from the tram and place it on the launch pad; and built and programmed a computer-driven rocket-firing mechanism. While the technology students were emulating NASA scientists (albeit on a smaller scale), students in other classes were also involved. Physics students applied physical principles and formulae to calculate and predict trajectory, distance traveled to apogee and average velocity. History students researched the history of rockets. Art students designed a logo for the project which, after much deliberation, English students dubbed "Project Zeus." Business students set up a data base of information for each launch and built a spreadsheet to analyze data and the costs associated with variable factors like wind speed. Because they could apply their classroom exercises to the ongoing rocket project, students were excited and more directly engaged in learning. Who knows where their studies and imagination might take them—they may "boldly go where no [one] has gone before."

Assistive Technology

Sierra sits in a circle of students who are entranced with an account of her recent trip to Minneapolis and the world's largest mall. She smiles, responds to questions, and lets her computer do her talking. No matter that the responses are pre-programmed into her portable computer; Sierra can engage people, interact and be understood in ways that her physical limitations have never before allowed. Sierra has cerebral palsy and severe physi-

The Vision: Scenarios - What's Possible

Assistive Technology, cont.

cal disabilities. Specially designed controls attached to her wheelchair allow her to operate both her chair and her computer with head and neck movements, and—thanks to specially designed software and parents who are only too happy to help her with input—her computer's memory is stuffed with comments that range from the more mundane, "I'm hungry, I'd like some fruit," to the story she's telling about her shopping adventures. As a result, Sierra has gained mobility and a certain amount of independence. Sure, she sometimes has trouble maneuvering through a crowd, but she now can tell whoever is blocking her path to "get out of the way."

No More "Dry Old" Book Reports

John and Elizabeth are learning about coral reefs in school. Fourth graders at Hawthorne Elementary in landlocked Helena, Montana, they are not only thousands of miles away from the nearest coral reef, they also live in a semi-arid ecosystem that bears little resemblance to a marine environment. Thanks to modern technology, however, John and Elizabeth have the world — Sea World, that is — at their fingertips. First, though, John and Elizabeth use books and encyclopedias to familiarize themselves with the animals, environment, and plant life endemic to coral reefs. Then they use a telephone connection to talk to staff at Sea World and get answers to their questions directly from marine biology experts. They broaden their research to include more "modern" resources like video tapes, CDs, and other on-line information services. After they finish their research, they compile the information they have gathered into a multi-media presentation. John and Elizabeth emerge from their learning experience with greater understanding and appreciation of the workings of a coral reef and, more generally, of other ecosystems.

Back to the Farm

Kim, Darby, and Scott are learning firsthand how agricultural markets are affected by different economic variables and, in turn, how the markets affect their families' farms. As members of the Dillon Future Farmers of America (FFA), they use satellite technology to monitor the various agricultural markets in the United States and around the world. Using a computer monitor and their satellite hook-up, these students have 24-hour access to the futures, financials, stocks, and commodities markets. They can also access various agricultural libraries and databases. Since her family runs a hog farm, Kim carefully tracks the historical and current price trends of porkbellies. Kim, Darby, and Scott all hope to take over the family business some day and are busy learning how to gauge market influence and market directions in agriculture. These students are already putting their knowledge to work on their families' fields and pastures. Their experience will stand them in good stead when each takes the helm of the family business.

Essential Learnings

There's no escaping technology and its impact; televisions, video games, and personal computers have firmly inserted it into our daily lives, often in inequitable and non-constructive ways. It is time to incorporate technology into the educational process. When planning for the 21st century, however, it is not enough to simply put the latest technological bells and whistles into every classroom. Research has shown that students' roles in the classroom should change along with the knowledge and skills they need to acquire in school. The classroom environment itself needs to change in order to assimilate that technology and to make effective, constructive use of it.

Research

The following was written by John Cradler and represents a summary of the findings of research and evaluation studies derived from several sources including state technology programs, the Report on the Effectiveness of Technology in Schools from 1990-1994, and a review of model technology schools.⁹

A. Outcomes for students and teachers related to technology applications

1. *Student Outcomes:* The effectiveness of technology tends to vary as a function of the curriculum content and instructional strategy delivered by the technology. When content and strategies are determined to meet accepted education standards, research shows that technology

- Increases performance when interactivity is prominent.
- Increases opportunities for interactivity with instructional programs.
- Is more effective with multiple technologies (video, computer, telecommunications, etc.).
- Improves attitude and confidence—especially for 'at risk' students.
- Provides instructional opportunities otherwise not available.
- Can increase opportunities for student-constructed learning.
- Increases student collaboration on projects.
- Increases mastery of vocational and workforce skills.
- Helps prepare students for work when emphasized as a problem-solving tool.
- Significantly improves problem-solving skills of learning disadvantaged students.
- Improves writing skills and attitudes about writing for urban Limited English Proficient students.
- Improves writing skills as a result of using telecommunications.

2. *Educator Outcomes:* Research on the benefits of technology for teaching is generally positive with a shift from the more traditional directive to a more student-centered approach. Research shows that educator use of technology results in

- Less directive and more student-centered teaching.
- Increased emphasis on individualized instruction.
- More time spent by teachers advising students.
- Increased interest in teaching.
- Interest in experimenting with emerging technologies.

Number of children in the U.S.:
67.4 million¹⁰

Number of K-12 students:
47 million¹¹

Number of babies born in 1992:
4 million¹²

One in four preschool-age
children live in poverty.¹³

Annual expenditures on entertainment and recreation:
\$340 billion¹⁴

Annual expenditures on elementary and secondary education (public and private):
\$270 billion¹⁵

Average age of Internet user
in 1994: 26¹⁶

Average age of Internet user
in 2000: 15¹⁷

Essential Learnings: Research

Lack of information literacy costs business an estimated \$25 to \$30 billion annually in poor product quality, low productivity and accidents.¹⁸

“The skillful use of technology and its knowledgeable application in a variety of settings is an absolute requirement for the educated person in today's world.”¹⁹

--The Oregon Educational Act for the 21st Century

Only 12-14% of U.S. classrooms have a telephone line.²⁰

Percentage of schools with at least one computer: 99%²¹

Percentage of school computers considered "obsolete" by the Department of Commerce's Information Infrastructure Task Force: 80%²²

Educator Outcomes, cont.

- Teacher preferences for multiple technology utilization.
- Increased administrator and teacher productivity.
- Increased planning and collaboration with colleagues.
- Rethinking and revision of curriculum and instructional strategies.
- Greater participation in school and district restructuring efforts.
- Business partnerships with schools to support technology.
- Increased education involvement with community agencies.
- Increases in teacher and administrator communication with parents.

B. Technology development and applications to support the teaching of learning

1. *Technology development factors:* Research shows that particular features of technology-based resources are critical for effective technology applications in education and should provide for or incorporate

- Immediate adjustment of task difficulty in relation to student responses.
- Instant feedback of correctness of responses.
- Ease of use by students and teachers.
- Sustained interest and use by students.
- Simulations of tasks not possible in the classroom or from books.
- Student control of pacing the educational programming.
- Opportunities for individualized problem solving.
- Opportunities to use multiple technologies.
- Built in assessments and procedures to match technology resources with learner needs.
- Field testing of technology-based resources with a variety of students in a variety of settings.
- Involvement in the development of educational technology programs.
- Alignment with curriculum frameworks and existing instructional resources.

2. *Technology application factors:* The following are general considerations that research and evaluation studies document as important features to include in the application of technology-based resources. The studies suggest that technology should provide for or promote

- Instruction that cannot be easily accomplished without the technology.
- Guidelines for teachers on how and when to integrate the technology into instruction.
- Expansion or enhancement of the curriculum.
- Integration into current and emerging curriculum standards and guidelines, i.e., interoperability.
- Access to technology and educationally relevant programs.
- Ease of use and high interest in any environment.
- The use of the technology within the regular classroom or learning environment.
- Adults that can promote meaningful student use of technology.
- Adapted uses of technology with diverse student populations.
- Involvement of teachers and administrators in the design and implementation of educational technology Research & Development.

Essential Learnings: Research

C. Local, state, and national factors to support effective technology applications

1. *Local teacher support factors:* Research consistently supports specific school and district-level program characteristics that enable teachers to effectively utilize technology. Such factors generally include

- Teacher awareness of effective technology applications.
- Time for teachers to plan, learn about, and implement technology applications.
- A social network of other technology using teachers.
- Availability of teacher mentors or other peer support.
- Involvement of principals and other administrators in the planning and training.
- Development of the knowledge to critique and select technology applications.
- Development of school and classroom-level technology plans by and for teachers.
- Involvement of teachers in deciding classroom uses of technology.
- Teacher access to technology while planning.
- Understanding of ways to integrate technology into education reform.
- Preparation of new teachers for effective integration of technology into teaching.
- Long-term staff development to support integration of technology into instruction.
- Increased opportunity for staff development and technical assistance.
- Access to technology and telecommunications resources.
- Awareness of and access to educationally relevant technology-based programs.
- Equitable access to centralized information resources related to technology use.
- Teacher—and student—access to computers outside of school.
- Opportunities for educators to communicate with peers in other schools and at conferences.
- School and district administrators committed to the use of technology.
- The systematic conversion of high-performance training technologies to support education.
- Shifting the media and telecommunications industry from entertainment to “edutainment.”

2. *State and federal program support factors:* Survey research and review of 20 state plans has documented particular state and federal program elements that promote effective technology use that include:

- Technology incorporated into existing and emerging education initiatives.
- Incorporation of technology applications into state curriculum frameworks and standards.
- Planning as a pre-requisite for receiving technology-based resources.
- Guidelines for local planning that promote funding allocations for staff development.

Hours U.S. children who have home video games spend playing them: 1.5 per day²³

Amount of TV watched by children ages 2-11: 23 hours, 41 minutes per week²⁴

Amount of own money children 12 and under spend annually: \$8.6 billion²⁵

Amount of own money children 13-18 spend annually: \$57 billion²⁶

Parental spending influenced by children annually: \$132 billion²⁷

“Information and Technology Literacy will be as much a part of 21st century life as knowing how to use a phone today.”²⁸

--*America's Children & the Information Superhighway*

Advertising expenditures on broadcast TV targeted at children: \$800 million²⁹

Age at which children start asking for brand-name items: 2³⁰

Essential Learnings: Research

"Technology will continue to change the nature of the learning process from a passive endeavor to an active one as students, young and old, access information and work with others from around the world."³¹

--North Central Regional Educational Laboratory

Home Video game revenues
1993: \$8.5 billion³²

Retail sales of all home educational programs 1993:
\$147 million³³

700 home educational software titles were on the market in 1994; It is projected that 250 additional titles will be released annually.³⁴

49% of college graduates with children reported that their children used a personal computer.³⁵

16% of those with a high school education or less reported that their children used a personal computer.³⁶

29%-39% of all students report that computers are frequently unavailable at school.³⁷

The top 20% of schools (i.e., those with the highest ratio of computers to students) have nine times as many computers as schools in the bottom 20%.³⁸

State and federal program support factors, cont.

- A statewide technology in education clearinghouse with electronic distribution.
- Incentives for the development and validation of technology-based resources.
- Incentives for identification and dissemination of programs and practices that work.
- Funding for school and district technology use plans that meet local and state criteria.
- An interagency governance structure to leverage resources across agencies for technology.
- Provisions for regional and local technology use training and technical assistance.
- A statewide interoperable electronic information highway accessible by all classrooms and learning environments.
- Both formative and summative evaluation of all programs.
- A process to communicate program accomplishments and problems to stakeholders.
- Information policy makers about cost benefits of technology applications in education.
- Technology uses incorporated into program review and assessment guidelines.
- Coordination of education, business, and other relevant governmental agencies.
- Business involvement in planning and implementing technology in education.

D. Considerations for an expanded Research and Development (R&D) agenda for educational technology

Most studies are formative and summative evaluations of various existing technology applications in education. Little funding has been expended for in-depth R&D for education—especially for grades K-12. So far the emphasis has been placed primarily on qualitative research and evaluation and less on development and validation. Industry has engaged in development, but that development has not been connected to research. Before technology can have a long-term impact on education, it is necessary to have a strong R&D agenda that promotes development combined with the needed research to inform the education community and the education stakeholders about effective practices and products. The research should help to determine the extent to which these new practices and products related to technology promote needed education reform. An expanded R&D agenda is important and should focus on the following:

- User friendly and educationally relevant information databases for the National Information Infrastructure (NII).
- Applications of technology to promote desired state and national education reforms.
- The use of telecommunications and distance learning for teacher staff development.
- Identification and dissemination of model technology programs, practices, and projects.
- Identification of occupational skills standards related to technology applications.

Essential Learnings: Research & Best Practices

R&D Agenda, cont:

- Using technology to disseminate information resources that provide systemic reform.
- Integration of technology into National Education Reform (Goals 2000, ESEA Reauthorization, School to Work, etc.).
- Development of effective educational software, multimedia, and video for school and home use.
- Study of the positive and negative consequences of technology on education and society.

R&D that addresses these and other priorities is critical if educators are to be knowledgeable about the effective use of technology to improve teaching and learning. Most educators believe that schools and teachers are not technologically equipped to prepare students for the 21st century. A strong R&D agenda with sustained financial support can help meet this national need.

Worldwide telecommunications revenues 1993: \$700 billion³⁹

Worldwide telecommunications revenues 2003: \$3 trillion (an increase of 428%)⁴⁰

American students rank behind Austria, Germany and the Netherlands in practical computer knowledge.⁴¹

Best Practices

In light of this research, the advisory committee derived a list of eight “best practices” that, in their experience, outlines the best way to prepare students for the 21st century.

1. Use a long-term focus with an emphasis on the empowerment and the efficacy of students. “We shape our future by present actions.”
2. Use a cognitive research base—concentrate on the human center and concentrate on whole person instruction and interaction.
3. Regard technology and computers as learning rather than teaching environments. Emphasize communication rather than rote learning or technical expertise.
4. Concentrate on education that is idea and problem centered and that is equitably applied across disciplines.
5. Stress collaborative education and communication rather than isolation.
6. Provide students with survival skills for a changing world and nurture the concept of global stewardship and connection.
7. Emphasize active learning and the development of critical thinking skills using real problems and enabling the creation of assignments and projects which are meaningful, relevant, and useful to the community.
8. Use technology as a viable tool to assist the physically, mentally or emotionally challenged. Used correctly, software is patient, more even-handed in response than humans, and can pace instruction and design individualized lessons.

Table 1: Framework for Educational Technology in Montana Schools	
Category	Description
1. Infrastructure	Hardware, software, and network capabilities.
2. Professional Development	Training and ongoing support for educators.
3. Curriculum Integration	Effective use of technology in teaching and learning.
4. Assessment and Evaluation	Measuring the impact of technology on student outcomes.
5. Policy and Governance	Establishing clear guidelines and standards.
6. Equity and Access	Ensuring all students have equal opportunities.
7. Safety and Security	Protecting student data and digital assets.
8. Collaboration	Encouraging shared resources and best practices.
9. Innovation	Exploring new and emerging technologies.
10. Leadership	Supporting visionary leadership in technology integration.

Table 2: Key Components of Educational Technology Integration

Component	Key Elements
1. Infrastructure	Hardware, software, and network capabilities.
2. Professional Development	Training and ongoing support for educators.
3. Curriculum Integration	Effective use of technology in teaching and learning.
4. Assessment and Evaluation	Measuring the impact of technology on student outcomes.
5. Policy and Governance	Establishing clear guidelines and standards.
6. Equity and Access	Ensuring all students have equal opportunities.
7. Safety and Security	Protecting student data and digital assets.
8. Collaboration	Encouraging shared resources and best practices.
9. Innovation	Exploring new and emerging technologies.
10. Leadership	Supporting visionary leadership in technology integration.

Essential Learnings: New Roles

New Roles in Learning, Living, and Working

As the Washington State Technology Plan states, the effective use of technology in the learning process requires that “students develop new roles in learning, living and working.” Both Washington and Alaska have identified new skills which these roles will involve. These skills or “essential learnings” should be woven into academic learning requirements in all subjects and areas.

The Washington Plan defines seven “essential learnings.”

1. The student as information navigator.

The student recognizes and values the breadth of information sources, browses those sources, differentiates and selectively chooses sources, and retrieves appropriate information/data using all forms of media, technology and telecommunications.

2. The student as critical thinker and analyzer using technology and telecommunications.

The student reviews data from a variety of sources, analyzing, synthesizing, and evaluating data to transform it into useful information and knowledge to solve problems.

3. The student as creator of knowledge using technology and telecommunications.

The student constructs new meaning and knowledge by combining and synthesizing different types of information through technology, telecommunications, and computer modeling/simulations.

4. The student as effective communicator through a variety of appropriate technologies/media.

The student creates, produces, and presents ideas and unique representations of

thoughts through a variety of media by analyzing the task before him/her, the technologies available, and appropriately selecting and using the most effective tool(s)/media for the purpose and audience.

5. The student as a discriminating selector of appropriate technology for specific purposes.

The student discriminates among a variety of technologies and media to extend and expand his/her capabilities.

6. The student as technician.

The student develops sufficient technical skills to successfully install, set-up, and use the technology and telecommunications tools in his/her daily life, work situations, and learning environments.

7. The student as a responsible citizen, worker, learner, community member, and family member in a technological age.

The student understands the ethical, cultural, environmental, and societal implications of technology and telecommunications, and develops a sense of stewardship and individual responsibility regarding his/her use of technology and telecommunications networks.

Essential Learnings: New Roles

Americans marveling at Thomas Edison's incandescent light and Alexander Graham Bell's telephone thought they were living in revolutionary times and they were. But by comparison we today are strapped to a rocket whose velocity and range we can only faintly comprehend. Computer technology is carrying us into an era when the production and distribution of knowledge and information will be vastly more important than the production and distribution of things. We have not begun to grapple with the implications of this for society, and especially for the way we earn a living, educate our children, and manage our economies.⁴²

*Mortimer Zuckerman, Editor-in-Chief
U.S. World and News Report*

The Alaska Technology Student Standards Committee focused on content standards and descriptions for what students should know in the following general areas:

- Understanding and operating technology;
- Using technology to access and select information;
- Using technology to solve problems;
- Using technology to express ideas and convey information;
- Understanding and evaluating the impact of technology; and
- Integrating technology into daily living.

The Current Status

Montana

Educational technology is being used in many exciting ways across Montana. The use of specific technology is often unique to the setting and varies from classroom to classroom and from teacher to teacher. As a result, it would be difficult to enumerate or describe the diverse applications of educational technology.

Following are short descriptions of some of the major uses of technology and networks currently operating and available in Montana. This list is certainly not exhaustive.

Big Sky Telegraph

Big Sky Telegraph (BST), created in January 1988 with grants from the M.J. Murdock Charitable Trust and US West, has provided the genesis for a dynamic, innovative telecommunications network geared to the needs of Montana's people and communities. Located on the Western Montana College campus in Dillon, Big Sky Telegraph equips educators, students, business people, and community members with state-of-the-art telecommunications access and information.

Big Sky Telegraph continues its progressive role as a leading telecomputing network with the delivery of Internet services and training. BST is connected "live" 24 hours a day to 3.2 million computer systems. Any of over 40 million people can simply type BST's Internet address and be connected with the equivalent of a free long distance phone call from anywhere in the world. Daily visitors from Brazil, Finland, Germany, and others appear on Big Sky Telegraph. BST has over 4,000 users per month.

Many of these Internet users are looking for teachers to participate in multi-classroom projects or for student penpals from other countries to correspond with their classes. By learning how to use telecommunications, students find that they can become "significant participants, no matter where they live." BST serves as a support test location for a diverse number of innovative online projects.

Full Internet services and E-mail are offered to Big Sky Telegraph's subscribers. BST makes it easy to explore dozens of easy-to-use menu-driven resources and to join thousands of interactive listservs.

BST provides on-line training and services to teachers and citizens statewide through distance learning opportunities, educational resources, community support services, economic development resources, and global communications via the Internet. BST currently has over 700 K-12 lesson plans available for users.

The Current Status: Montana

Big Sky Telegraph, cont:

The skills to navigate the global information highway, to access information and communicate with people worldwide, are becoming increasingly important. Development of the National Information Infrastructure (NII) will unleash an information revolution that will change forever the way people live, work, and interact with each other. Big Sky Telegraph's easy-to-use menus help ensure that users can transfer information across networks easily, efficiently, and affordably.

EDUNET

EDUNET is a distance learning computer network that electronically provides classes to any computer and modem in the United States. Its goal is to provide "interactive education through telecommunications." First started in 1984 by Lee Holmes and Paul Dorrance at Helena High School, the network moved to its current base in Saco, Montana, where it is hosted by the Saco public schools. Both IBM compatible or MacIntosh computers with 1200, 2400, or 9600 baud modems can access this network. Training is available on-line and on-site.

EDUNET serves as a link between students and teachers and provides customized service for varying needs. The first courses offered in the system were basic drafting and electronic courses. Since then the course offers have expanded to include 40 courses in a variety of subjects including, but not limited to, math, science, English, history, foreign languages, and business. Assignments and helpsheets are stored on-line, to be downloaded as needed. EDUNET's primary participants are rural schools and the most requested courses are foreign languages.

EDUNET is a non-profit organization intended to provide educational opportunities for schools and students that would otherwise go without. The cost for enrolling is \$250 per student per semester course. The network also furnishes free public domain access to files from various educational groups in the Western United States. The network also provides free public domain access to files supplied by different educational organizations in California, Idaho, Montana, and Washington with a focus on anti-drug and alcohol programs for schools.

Headmaster

Headmaster is a distance learning service which provides individual, skill-based, mastery learning courses to students who use computers and modems all across the country. Started in 1982 by Paul Dorrance and Ben Schmidt and based in Helena, this service offers over 40 courses taught by endorsed teachers. Course offerings range from languages to sciences, mathematics to business, elementary to adult, and high school to college level. It is designed so that students "essentially get their own 'private' tutor." Teachers contract with Headmaster and receive a percentage of all monies generated by the course they teach.

The Current Status: Montana

Headmaster, cont:

Headmaster is funded by a user fee of \$240 per student per 90 hours of instruction. Headmaster now uses a telecommunications software package that automates the telecommunications aspect of the distance learning process and makes it possible for students and teachers to quickly connect, access, and transfer the correct files. The service provides continual access to the network so that teachers and students can interact with each other around the clock.

SIMMS

The Systemic Initiative for Montana Mathematics and Science (SIMMS) is a project designed to promote mathematics education for all students. It represents a partnership of the Montana Council of Teachers of Mathematics, the Montana Legislature, the Montana Office of Public Instruction, the Montana University System, the Montana Advisory Council, the National Science Foundation, and Montana businesses and largely relies upon federal funding.

The SIMMS project promotes reform in science and mathematics education by redesigning the mathematics curriculum for grades 9-12 using an integrated, interdisciplinary approach for all students. The SIMMS curriculum emphasizes problem solving, mathematical reasoning, real-world applications, and the appropriate use of technology. In order to achieve this reform, SIMMS has formulated the following project goals: ⁴³

- to develop and publish curriculum and assessment materials for grades 9-16;
- to incorporate the use of technology in all facets and at all levels of mathematics education;
- to increase the participation of females and Native Americans in mathematics and science;
- to establish new certification and recertification standards for teachers;
- to redesign teacher preparation programs using an integrated, interdisciplinary approach;
- to develop an inservice program on integrated mathematics to prepare teachers of grades 9-16; and
- to develop the support structure for legislative action, public information, and general education of the populace necessary for effective implementation of new programs.

Star Schools

Star Schools is a federally funded education program designed to provide instruction to students in remote sites by using satellite transmissions, telephone lines, fax capabilities, scanners, computers, and video cassette recorders. The original program was developed in 1989 with

The Current Status: Montana

Star Schools, cont:

grants from the U.S. Department of Education. Five states in the Northwest—Montana, Idaho, Washington, Oregon, and Alaska—joined together to write a grant to develop the Northwest Star Schools Partnership which built upon an existing satellite telecommunications project operating from Spokane, Washington, and Washington Educational Service District 101 (ESD-101).

In 1993, the Northwest Star Schools Partnership collaborated with other Star Schools Projects throughout the country to form the Interactive Distance Education Alliance Network (IDEANET). The formation of IDEANET provided participating schools with a much broader selection of distance learning providers and courses. In 1994, the Pacific Islands joined the partnership.

The technical center of the Star Schools Program functions is ESD-101, which houses the studios and satellite broadcast equipment necessary to produce the educational programming which is then broadcast via satellite to all member schools. Member schools are provided with satellite dishes, receivers, computers, scanners, and related equipment.

While the classes are being broadcast, a data stream is being transmitted on a subcarrier of the satellite signal to the computers. Classroom data, tests, program information, and individual student data are transmitted via this subcarrier to various classrooms. Students who participate in the programming can interact with classroom instructors by using toll free lines, fax machines, and computer modems. They can video tape classes for additional or future review and transmit their work back to ESD-101 via E-mail or fax for evaluation by teachers' aides. All participating teachers are certified and accredited in Montana. The Star Schools program is currently slated for rescission by the 104th U.S. Congress.

METNET

The Montana Educational Telecommunications Network (METNET) was created by the 1989 Montana Legislature. The legislation provided for three agencies—the Office of Commissioner of Higher Education, Department of Administration and the Office of Public Instruction—to cooperate to “support education, economic development and government services in the state” through the provision of telecommunications services.

The agencies worked cooperatively on the following projects:

- **Equipment Grants**

The METNET legislation provided grants to purchase and install telecommunications equipment in schools and university system units throughout the state.

The Current Status: Montana

METNET, cont:

- **Computer Bulletin Board Systems**

In September of 1991, the METNET agencies began to develop a statewide computer-based bulletin board system (BBS) designed to facilitate communications between educators in K-12 education and the university system. A total of 15 regional training sites were identified by the Commissioner of Higher Education and K-12 school superintendents and between November 1991 and August 1992, 16 BBS nodes were installed in sites all over the state.

Each BBS has a local, state, and national/international conference area. Communications between the sites are exchanged daily, and non-local conferences are available on any node in the METNET system.

- **Computer Networks and E-mail**

During the installation of the BBS nodes, the METNET program also installed 15 computer networks in each of the regional training centers. The computer networks were installed as a resource tool for the regional training sites and include communications capabilities with electronic mail between the regional training centers and the OPI. Each regional site has an active electronic mail node which is accessible by remote users in that region.

- **Inservice Training**

The METNET program sponsored over 100 inservice training programs in Montana schools during the 1991/92 school year. The programs included basic bulletin board system training, basic satellite skills, and fundamentals about distance learning.

- **Compressed Video**

The METNET program, University of Montana, Eastern Montana College, and Montana State University cooperated in the development of the first compressed video system nodes in Montana education. The sites selected for compressed video were Missoula, Billings, Bozeman, and Helena. METNET's two-way video network will allow users to hold interactive video conferences between the video locations, to access the satellite uplink transmitter at MSU for statewide satellite video teleconferences, and to conduct interactive video classes, training, and hearings between cities.

- **Satellite Communications**

The METNET program continues to look toward developing Montana-sponsored, satellite-delivered courses which would be made available to Montana schools.

- **METNET Funding Update**

In 1993, the Montana Legislature eliminated state support for equipment grants and technology expansion but allocated funding for continued METNET BBS operations. The compressed video network continues to be operational and supported by user fees. Expenditure authority was granted to the METNET program based upon the ability to obtain private contributions for network expansion. In 1995, the Montana Legislature neither increased nor decreased state support for METNET.

The Current Status: Montana

SummitNet

SummitNet is a network which provides data communication services for Montana's fast growing multi-protocol network environment. This network connects the state's local area networks (LANs) with the growing base of mid-range computers being installed in state agencies. While SummitNet currently links only 12 cities in 12 counties, its proposed expansion and upgrade would result in a true peer-to-peer digital network linking 64 cities in all of Montana's 56 counties, including the entire university system and seven Native American tribal community colleges (see SummitNet Map in the Appendix).

Though SummitNet is configured as a backbone system, its proposed expansion and upgrade will interconnect the state's schools, libraries, universities, tribal colleges, and state and local government agencies. In addition to providing access to information services and the Internet, the improved SummitNet configuration will be capable of carrying distance learning and telemedicine programs. These capabilities are of critical importance to a state such as Montana with its immense geographic size and sparsely distributed population.

Largely because of its reliance on the public network, SummitNet represents a cost-effective and efficient plan. The ability to take advantage of new service offerings on the public network helps SummitNet guard against obsolescence while at the same time promoting flexibility.

While the SummitNet proposal is certainly justified by changing technology and cost-effectiveness, emerging customer needs have proven to be driving forces in the proposal's development. For example, the Montana Department of Health's National Immunization Program and Electronic Birth Certificate System will require the LAN connectivity provided by SummitNet to communicate with county health departments, hospitals, doctor's offices, and other interested health care providers. The need for this type of network connectivity also has been expressed by other agencies as well as local governments, libraries, schools, and universities.

SummitNet and its proposed expansion represent the culmination of a collaborative process involving state and local government agencies, public interest groups and the private sector. The involvement of these diverse interests in the development of the proposal has resulted in broad-based support for the final product. SummitNet represents the future of information and network technology in Montana. With its vast size, sparse population density, and diverse educational structure, the state of Montana requires an advanced telecommunications infrastructure to take advantage of all the benefits and opportunities of the information age.

The Current Status: Montana

Montana Technology Survey

In November of 1994, the Montana Office of Public Instruction asked Montana school districts for information about the technology in their districts. The following findings gleaned from this inventory provide insight into the technology availability in the schools, but does not detail the uses of that technology. A total of 322 districts responded. This represents 69 percent of the districts enrolling 69 percent of the students. (See Appendix for a breakdown of the collected data.)

- District technology plans have been adopted in only 22 percent of the districts. And, in a state as rural as Montana, only 20 percent of the districts are using distance learning. Access to the Internet is reported for only 19 percent of the districts.
- Montana schools have approximately 28,652 computers. That's one per 7.7 elementary students, one per 3.5 high school students, and one per 5.7 students overall. But we do not know what educational uses are made of the computers. A portion of them are most likely inaccessible to students. Computers that have administrative use are rarely accessible to other users.
- The computers are split almost evenly between high school and elementary levels. 53 percent of the computers are utilized at the elementary level and 47 percent in grades 9-12. However, Montana schools enroll almost 2.5 times as many elementary students as high school students. Therefore, elementary students have less access to computers than high school students.
- 83 percent of the reporting districts have IBMs, 67 percent have MACs, but 89 percent still have Apples. Only 13 percent reported having any other type. About two-thirds of the IBMs, MACs, and other computers are in the high schools; Apple use, however, is reversed—two-thirds are at the elementary level.
- Although more districts have Apples than other kinds of computers, there are more IBM machines actually being used in the schools. IBM (or compatible) machines make up 39 percent of the total computers used, Apples make up 32 percent, MACs comprise 28 percent, and only 1 percent are other kinds of computers.
- Each of the brands of computers is available to a variety of users. Students have access to computers in 74 percent of the districts with Apple computers, 72 percent of the districts with MACs, and 64 percent of the districts with IBMs.
- IBM computers appear to be the administrative computer of choice--64 percent of the districts with IBMs report that administrators use them. Administrators use MACs in 44 percent of districts reporting MACs, and 12 percent of districts having Apples report that administrators use them. Teachers use computers in 70 percent of districts with MACs and in 61 percent of districts with IBMs, Apples, and other computers. Librarians use them in 44 percent of districts with IBMs, 38 percent with MACs, and 17 percent with Apple.
- Districts also provide community access to computers. 25 percent of districts with IBMs, 16 percent with MACs, and 5 percent with Apples report that the community has access to their computers.
- School access to other types of technology varies widely. Districts reported one printer for every 2.5 computers, one CD-ROM for every 12.6 computers, one modem for every 19.7 computers, and one LASER disk player for every 62 computers. 46 percent of the districts reported having FAX machines, 53 percent of the districts had METNET access, 35 percent had cable, and 9 percent had fiber optic capabilities.

Introduction

Background and Purpose

The purpose of this document is to provide a framework for thought in educational technology. It is designed to help educators understand the role of technology in the classroom and to provide a set of guidelines for the effective use of technology in education.

The first section of the document discusses the importance of technology in education. It highlights the ways in which technology can be used to enhance learning and to provide a more personalized and engaging educational experience for students.

The second section of the document discusses the challenges of implementing technology in the classroom. It identifies the barriers to adoption and provides strategies for overcoming these challenges.

The third section of the document discusses the role of technology in the classroom. It provides a set of guidelines for the effective use of technology in education, including the selection of appropriate technology, the integration of technology into the curriculum, and the assessment of student learning.

The fourth section of the document discusses the future of educational technology. It explores the emerging trends in the field and provides a vision for the role of technology in education in the years ahead.

The fifth section of the document discusses the role of technology in the classroom. It provides a set of guidelines for the effective use of technology in education, including the selection of appropriate technology, the integration of technology into the curriculum, and the assessment of student learning.

The sixth section of the document discusses the future of educational technology. It explores the emerging trends in the field and provides a vision for the role of technology in education in the years ahead.

The seventh section of the document discusses the role of technology in the classroom. It provides a set of guidelines for the effective use of technology in education, including the selection of appropriate technology, the integration of technology into the curriculum, and the assessment of student learning.

The eighth section of the document discusses the future of educational technology. It explores the emerging trends in the field and provides a vision for the role of technology in education in the years ahead.

The Current Status: U. S.

National Technology Survey

The following information represents selected findings from a survey requested by the U.S. Department of Education and conducted by West, Inc., a research firm in Rockville, Maryland, through the National Center for Education Statistics (NCES) Fast Response Survey System.

- Overall 35 percent of public schools have access to the Internet but only 3 percent of all instructional rooms (classrooms, labs and media centers) in public schools are connected. Only 30 percent of public elementary schools have Internet access compared with 49 percent for secondary schools.
- Funding is the major barrier most often cited in the acquisition or use of advanced telecommunications in public schools. Schools cited funding as a major barrier 69 percent of the time and ranked it first in a list of potential barriers. Other major barriers most often cited were the lack of equipment or poor equipment and too few access points in the school building.
- 75 percent of public schools have computers with some type of telecommunication capabilities (i.e., LAN or WAN), 74 percent have cable television, and 70 percent have access to broadcast television in their schools.
- Only 40 percent of public schools having computers with telecommunication capabilities indicated that they were located in classrooms. The types of telecommunications most often located in classrooms are broadcast and cable television. Although 94 percent of schools with closed-circuit television reported it was in classrooms, only 25 percent of schools had this capability.
- 67 percent of public schools have plans to implement or upgrade a wide area computer network. Of these, 81 percent indicate that their telecommunications plans are part of a district-level plan, 48 percent are part of a school-based plan, 27 percent are part of a state plan, and 19 percent are part of a regional plan.
- Smaller schools with enrollments of less than 300 are less likely to be on the Internet than schools with larger enrollment sizes. Only 30 percent of small schools reported having Internet access, while 48 percent of schools with enrollments of 1,000 or more reported having Internet access.
- For the public schools having access to the Internet or any other wide area network connection:
 - 11 percent of the schools having access to WANs indicate that administrative staff use those networks to a large extent, but only 3 percent indicate that students and 2 percent indicate that teachers use the network to a large extent.
 - Schools with access to WANs indicate that district and regional administrators (48%) and teachers and other staff (33%) are the two groups most likely to play a large formal role in developing the school's telecommunications program.

The Current Status: Nationally

As technology — especially telecommunications and electronic technology — develops and expands, our workplace changes and the rest of the world knocks on our door.

- 98.3 percent of U.S. households have a TV.⁴⁴
- 94.9 percent have basic telephone service.⁴⁵
- 85 percent have a VCR and 63 percent have cable TV.⁴⁶

A global economy ensures stiff competition for jobs which increasingly require technologically skilled workers. As cited in *America's Children & the Information Superhighway*, the better paying jobs today require information technology skills as well as strong basic skills like reading, writing, calculating, and critical thinking.

- In 1984, 25 percent of workers used computers on the job; in 1993, 47 percent did.⁴⁷
- Two-thirds of college graduates use computers at work, compared to fewer than one-tenth of high school dropouts.⁴⁸
- In the early 1990s, workers with computer skills earned 10-15 percent more than workers without such skills.⁴⁹

This is not something just individuals need to consider when making career decisions; the “stakeholders” in our children's lives are numerous and encompass most of our society. The Washington State Educational Technology Advisory committee defined the “stakeholders” in a child's life as including, but not limited to, “educators and support personnel from all levels, students, parents, community members, business and industry representatives, labor and union representatives, government agencies, the State Board of Education, and the legislature.”⁵⁰

The lack of “information literacy” costs businesses billions of dollars annually,⁵¹ and that figure does not even reflect the human toll caused by unemployment or steadily declining incomes.

The inclusion of funding for educational technology in recent federal legislation is a positive indication as are the numbers of states and school districts which have either developed or are developing educational technology plans.

“All who have meditated on the art of governing mankind have been convinced that the fate of empires depends on the education of youth.”

—Aristotle

“Connections by schools into the communications infrastructure no longer appear to be luxuries, but necessities if our schools (and our learners) are to gain knowledge that is relevant in tomorrow's world.”⁵²

—Prof. Dennis Gooler

“At the desk where I sit, I have learned one great truth. The answer for all our national problems—the answer for all the problems of the world—comes to a single word. That word is *education*.”

--Lyndon B. Johnson

Special Concerns

Private carriers and technology marketing firms respond to marketplace forces —whether they be determined by financial resources, location, or gender. If profit and current commercial strategies are allowed to be the sole determining forces in access, research and development, and distribution, certain groups will be excluded in one way or another from the possible benefits of technology.

Our nation's poor children are at grave risk in the information age.

- While 65 percent of households in America with incomes over \$100,000 now have a personal computer, only 11 percent of households with incomes below \$20,000 have them. This is compounded by the high percentage of American children who live in poverty.⁵³

Gender also plays a role in access to technology.

- Boys use computers more than girls and most video games for home computer use are marketed for boys.⁵⁴
- 85 percent of computer game users are boys and males comprise 85 percent of those who use Internet and other on-line services.⁵⁵

Given their relative isolation and financial limitations, rural students are also at risk.

- Many rural areas went without phone service for decades until legislation was passed which subsidized rural service. Even today only 94.9 percent of the nation's households have phones while 98.3 percent have television sets.⁵⁶
- A recent analysis of four Baby Bells' plans to bring video dialtone service (which would install a fiber-optic network) to eight cities revealed a pattern of bypassing low income and minority communities.⁵⁷

“The market, alone, cannot be depended upon to supply the educational age-appropriate and socially appropriate programming that all children need. Simply providing a new conduit for commercialism wastes the potential...to benefit children.”⁵⁸

—*America's Children & the Information Superhighway*

Lessons from History

The benefits of past technological advances have not always been equitably distributed or lived up to their educational potential. The delay of phone service to rural areas is one such example. In the 1980s, computers began to appear in the classrooms, but they did not widely have the expected impact on educational learning and teaching conditions. This disappointment has, in large part, been attributed to the following:⁵⁹

- The failure to fully enlist teachers and provide adequate teacher training;
- The failure to integrate technology into the classroom;
- The failure to fully involve parents;
- The failure to provide an adequate support system- both financial and otherwise; and
- The failure to develop appropriate software.

“Private telecommunications carriers respond to marketplace forces, and, therefore, are most likely to exclude those members of the public and institutions with the fewest financial resources.”

--Senator Daniel Inouye

The Challenge for Tomorrow

Technology in its many forms has become a factor in almost all aspects of our lives. If we want our school children—and our state—to be prepared for the 21st century, it is time to integrate technology into Montana's schools and classrooms.

How should Montana effectively plan for improved student learning through the use of technology in all schools? What is our vision for Montana's schools, classrooms, teachers, and students? What is to be the role of technology in Montana public schools and what are the gaps between that vision and Montana's current educational status? What steps and resources are necessary to bridge those gaps?

The challenge that lies before us is to

1. identify the gaps;
2. set goals that will bridge those gaps; and
3. develop thoughtful, specific recommendations of how those goals can be attained.

These are the steps that are key to formulating effective recommendations for translating today's goals and visions into tomorrow's reality.



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Appendix A

Technical Glossary

This glossary was gleaned from many sources including Datapro's *Glossary of Microcomputing Terms*; Digital's *Guide to Personal Computing*; Telecomreg *FAQs*; and *America's Children and the Information Superhighway*.

A/B Switch: A coaxial or high isolation switch used for selecting one of two input signals; for example, a cable line and a broadcast antenna.

Access Channel: A dedicated channel giving non-discriminatory access to a cable system by the public, government agencies, or schools. Cable operators generally cannot dictate how an access channel is programmed; the channels are generally run by independent non-profit groups, schools, or governments.

Address: A computer system location that can be referred to in a program. An address can define a main memory location, a terminal, a peripheral device, a cursor location, or any other physical item in a computer system.

Advanced Telecommunications: Modes of communication used to transmit information from one place to another including broadcast and interactive television, networked computers, etc.

Architecture: The design and interrelationship between the components of a computer system.

Artificial Intelligence: The capability of a computer to perform functions that are normally associated with human intelligence, such as reasoning, learning, and self-improvement.

Asynchronous: A communications method in which data is sent as soon as it is ready, as opposed to methods in which data is sent at fixed intervals.

BITNET ("Because It's Time" Network): An electronic mail network connecting 300+ universities as well as major European and Asian academic data networks; see also Internet.

BPS (Bits Per Second): A measure of the amount of data transmitted in a fixed amount of time.

Bridge: A communications device that passes information between two separate networks.

Broadcast Television: network television such as NBC, CBS, etc.

Buffer: A temporary storage area for data, frequently used to hold data being passed between computers or other devices, such as printers, which operate at different speeds or different times.

Bulletin Board System (BBS): A central computer that you can connect to over a phone line using your own computer and modem. Most BBSs offer files, programs and other information that you can download to your own computer, and some enable you to send E-mail and communicate with other users who are connected at the same time.

CD-ROM (Compact Disk Read Only Memory): A disk that stores large amounts of textual and audiovisual information used with personal computers that have CD-ROM "drives." In other words, it only plays back information, so unlike "floppy disks," CD-ROMs cannot record — at least not yet.

CPU (Central Processing Unit): Electronic components in a computer that control the transfer of data and perform arithmetic and logic calculations. This is the "brains" of the system—the functional part of the computer that reads, interprets, and executes instructions.

Circuit: (a) A system of semiconductors and related electrical elements through which electrical current flows. (b) In data communications, the electrical path providing one-way or two-way communication between two points.

Appendix A: Glossary

Closed-circuit Television: The transmission of television on noncommercial lines (e.g., inhouse broadcast).

Coaxial and Fiber-Optic Cables: High-speed, high-volume carrying lines. Coaxial cables (or "coax") are wires in which one conductor surrounds another. Used by the phone companies since 1940, they carry information for telephone, radio, and television. Fiber-optic cables (or "fiber") transform information (video or text) to pulses of light which are transmitted on incredibly fine glass cables to computers which turn the pulses into images. Today's best fiber telephone lines can carry 10,000 times more information per second than a traditional copper wire — and scientists expect further improvements over the next decade.

Compatibility: (a) The ability of an instruction, program, or component to be used on more than one computer. (b) The ability of computers to work with other computers that are not necessarily similar in design or capabilities.

Compression Technology: A technique that allows transport of multiple video signals within a 6 MHz (or equivalent) band width.

Computer Network: An interconnection of computer systems, terminals and communications facilities.

Configuration: The assortment of equipment (disk drives, diskettes, terminals, printers, etc.) in a particular system.

Cyberspace: General term used to refer to the electronic "areas" and communities existing on the Internet and other computer networks.

DBS (Direct Broadcast Satellite): "Cable" service using a satellite dish. Generally refers to high-power satellite that can be received by small 18-24 inch dishes.

Digital: Information expressed in binary code; digital transmissions are by discrete signals (bits) rather than continuously variable analog waves. Digital

processing and transmission allows for very high-speed data communication, voice processing, and compressed video.

Distance Education, Distance Learning: The application of information technology (and infrastructure) to educational and student-related activities linking teachers and students in differing places.

Distant Signal: A broadcast station from another market imported and carried by a cable system.

Downlink: A transmission link from a satellite to a ground receiving station.

E-Mail (Electronic Mail): A way of addressing and sending messages electronically from one computer to another. Users can send memos, letters, and other text-based messages, as well as multimedia documents.

Emulator: A program that allows a computer to imitate a different system, thus enabling different systems to use the same data and programs to achieve the same results, but with possible different performance rates.

Expansion Slot: The space into which additional cards (boards) are inserted into a motherboard in a system unit.

FDDI (Fiber Distributed Data Interface): An emerging standard for computer LANs operating at 100 MBPS over fiber optic cable.

Gopher: Software which permits searching files on the Internet on remote hosts using layered menus. Text from these files can be read online or the files can be transferred to your computer.

Hardware: The nuts, bolts, and wires. The actual computer and related machines.

Head: A component that reads, writes, or erases data on a storage medium such as a diskette or disk. A "head crash" is the physical collision of the read/write head and the recording surface of magnetic media. It usually results in the destruction of data.

Appendix A: Glossary

Host Computer (Mainframe): The primary or controlling computer in a multiple computer network operation. This computer normally provides high-level services such as computation, database access, or special programs or programming languages for other computers in the network.

Information Literacy: The ability to access, manipulate and produce information using current technologies. Information literacy is based on strong reading, writing and calculating skills and is aimed toward developing critical thinking, problem-solving, and lifelong learning skills (see related term: Technology Literacy).

Information Superhighway: A term popularized by Vice President Al Gore. The information superhighway is envisioned as a global high-speed network of computers that will serve thousands of users simultaneously, transmitting E-mail, multimedia files, voice, and video. This system is expected to link homes, offices, schools, libraries, and medical centers, so that textual and audiovisual information can be instantly accessed and transmitted from one computer screen to another (see related term NII).

Instructional Rooms: Rooms in the school building used for any instructional purposes (includes classrooms, labs, media centers, art rooms, rooms used for vocational or special education, etc.).

Interactive: Capable of carrying on a dialogue through a keyboard with the user, rather than simply responding to commands.

Interactive Media: A broad term for two-way electronic communication. Interactive TV includes home shopping, video-on-demand, and a variety of games and entertainment in many different formats, which provide the user with choices for learning or play. CD-ROM and other computer software can also be interactive — between the user and the program. To be distinguished from essentially “one-way” media such as traditional radio, television and movies.

Interface: An electronic assembly that connects an external device, such as a printer, to a computer.

Internet: The global “networks of networks” that connects corporations, small businesses, universities, and individuals, giving them access to databases throughout the world. Every Internet user can send E-mail to every other Internet user. The Internet alone is not the information superhighway, but an existing system that would be one element of the superhighway.

ISDN (Integrated Services Digital Network): A telephone-based hierarchy of digital switching and transmission systems that provides voice, data, and video in a unified manner. A new standard for end-to-end digital networking.

ITFS (Instructional Television Fixed Service): Local (@ 25 mile radius) one-way broadcast channels that operate at very high microwave frequencies.

JPEG (Joint Photographic Experts Group): A group that sets the standards for digitalization of photographs. It is also a still-picture compression method which was developed by this group.

LAN (Local Area Network): Data communications network with a limited geographic area, usually single or a few contiguous buildings.

Mainframe: A computer that is physically large and provides the capability to perform applications requiring large amounts of data. These computers are much more expensive than microcomputers or minicomputers.

Media Policy: Government rules, regulations or guidelines for radio and television (see related term: Telecommunications Policy).

Memory: (a) The main high speed storage area in a computer where instructions for a program being run are temporarily kept. (b) A device in which data can be stored and from which it can later be retrieved.

Menu-driven: A computer system that primarily uses menus for its user interface rather than a command language.

Appendix A: Glossary

Microcomputer: A computer which is physically very small. It can fit on a desk. Usually the least expensive of the computer types.

Minicomputer: A type of computer whose physical size is usually smaller than a mainframe. In general, its performance exceeds that of a microcomputer.

MMDS (Multi-channel, Multi-point Distribution System): Commonly known as “wireless cable.”

Modem: Short for “modulate-demodulate,” a device which allows computers to communicate over telephone lines or other delivery systems.

Multimedia: A combination of two or more types of information such as text, audio, video, graphics, and images.

Network: A group of computers that are connected to each other by communication lines to share information and resources.

Newsgroups: Electronic conferences/discussion groups similar to mail lists. Newsgroup messages, called articles, are not mailed to a subscriber's E-mailbox but are distributed to a subscribing system's news server. This single copy is then accessed by all users on their network-connected machines. Each newsgroup focuses on a subject area.

New Media: A term which encompasses interactive TV, CD-ROMs, video games, and on-line systems.

New Technologies: The new ways of storing, accessing and transmitting information, combining applications of the telephone, television, and computer.

NII (National Information Infrastructure): The United States Government's official term for the “Information Superhighway.” In some ways, “infrastructure” is a more accurate description of a wired, interconnected world than the more linear “superhighway.”

NREN (National Research and Education Network): The proposed, federally-funded, high capac-

ity digital “electronic highway” providing the backbone links for the Internet.

One-way Video With Two-Way Audio or Two-way Computer Link: The ability to transmit or receive a picture in one direction with the capability to communicate in two directions (interactively) via computer or some audio method.

On-Line or Online: Connected, linked. Working on a single computer is not being on-line. Working on a computer linked to other computer information services or “bulletin boards” is being on-line. “Online services,” such as America Online or CompuServe, are private electronic areas where subscribers to the system can exchange typed messages, access information, pictures, etc.

Operating System: A collection of computer programs that controls the overall operation of a computer and performs such tasks as assigning places in memory to programs and data, processing interrupts, scheduling jobs, and controlling the overall input/output of the system.

Optic Fiber: Hair-thin glass fiber which allow light beams to be bent and reflected with low levels of loss and interferences.

PPP (Point to Point Protocol): A protocol that allows a computer to use the TCP/IP (Internet) protocols (and become a full-fledged Internet member) with a standard telephone line and a high-speed modem. PPP is a new standard for this which replaces the Serial Line Internet Protocol (SLIP). Although PPP is less common than SLIP, it is quickly increasing in popularity.

Peripheral: A device that is external to the CPU and main memory (e.g., printer, modem, or terminal) but connected to it by appropriate electrical connections.

RAM (Random Access Memory): Memory that can both be read and written into during normal operation. RAM is the type of memory used in most computers to store the instructions of programs currently being run. When you turn the machine off, everything in RAM disappears.

Appendix A: Glossary

ROM (Read Only Memory): Memory containing fixed data or instructions that is permanently loaded during the manufacturing process. A computer can use the data in the ROM, but cannot change it.

Software: A computer program; loosely defined, a package of information to be used on your hardware.

SMATV (Satellite Master Antenna TV System): Uses a satellite dish to distribute cable programming to an entire building.

Technology Literacy: The ability to use, understand, and manipulate new tools like computers and other telecommunications devices (see related term: Information Literacy).

Telecommunications Industry: Phone companies and their communications satellites, cellular services, wireless transmitters, etc. Mergers with the entertainment industry (such as broadcast and cable TV) will expand the definition to include all information.

Telecommunications Policy: Government rules, regulations, or guidelines for the electronic communications industry, i.e., telephone, broadcast and cable television companies (see related term: Media Policy).

Telecommuting: Commuting to another location electronically instead of physically; for example, by computer and telephone.

Two-Way Video and Audio: The ability to transmit and receive picture and sound simultaneously in real time.

Universal Service: The availability and accessibility of a service (in this case, technology for interactive communications) to people in every home and community. Telephone service is nearly (but not fully) universal in the United States.

Upgrade: To expand your personal computer or a computer system as new features are developed or as existing features are enhanced.

Uplink: A transmission link from an earth station to a satellite.

VERONICA: An Internet search tool that does keyword searches of indexes of Gopher documents. The acronym stands for "Very Easy Rodent-Oriented Net-wide Index to Computerized Archives."

Video Teleconference: Real-time, usually two-way transmission of video images between two (or more) locations.

Virtual Reality: Computer-generated visuals simulating a real or imaginary environment. Also known as "VR."

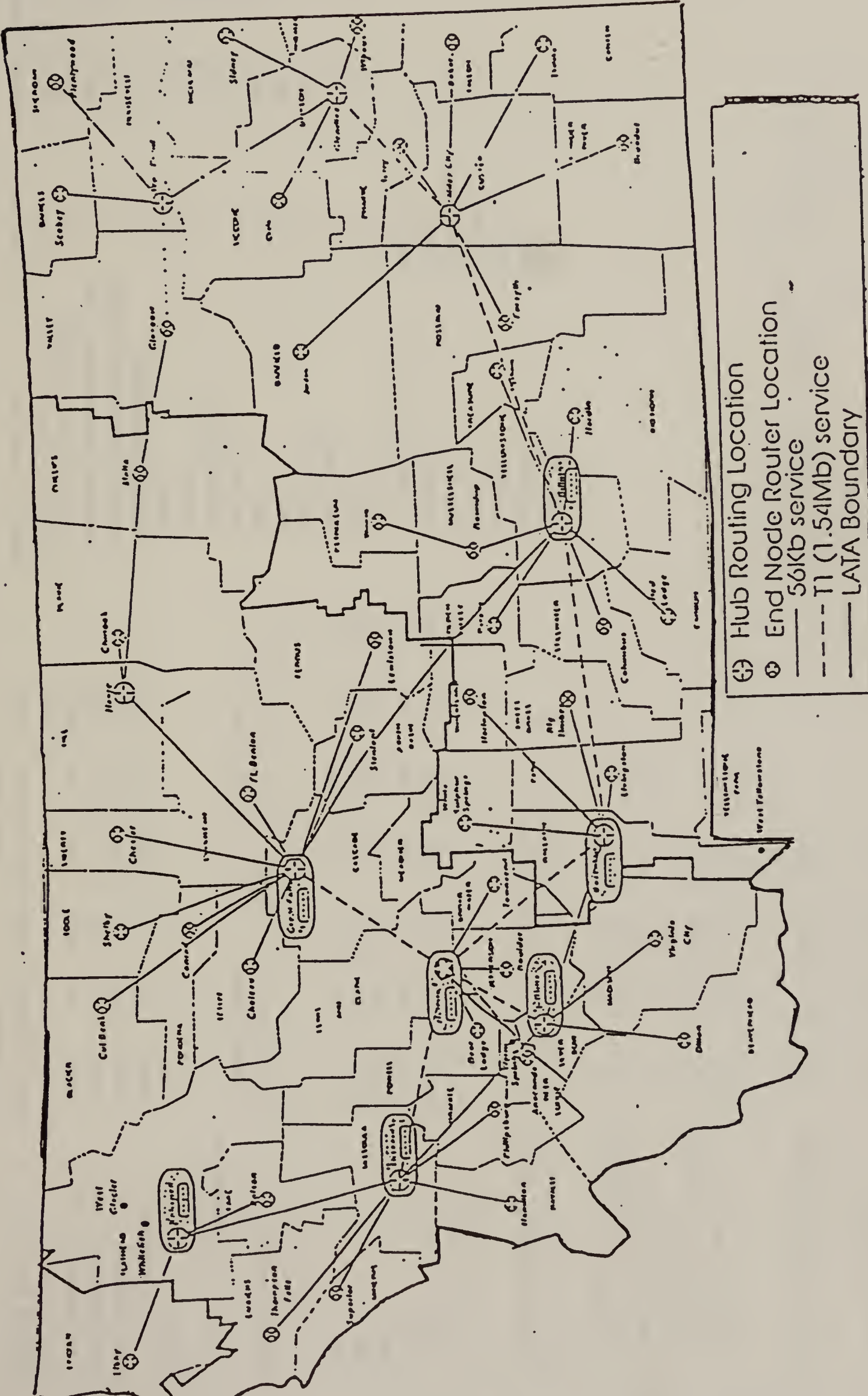
VSAT (Very Small Aperture Terminal): Small satellite receiver dishes which make it economical to serve isolated locations with voice, video, and data services. Two-way VSATs allow for return data transmission.

WAN (Wide Area Network): A data communications linkage designed to connect computers over distances greater than the distance transmitted by local area networks (for example: building to building; city to city; across the country, or internationally) that allows users to communicate and share information.

Wireless Cable: A system transmitting TV signals to subscribers via microwave rather than coaxial cable.

Wireless Systems: Transmission of information through the airwaves without the use of wires, as in the case of devices including cellular phones, and paging and messaging services.

Appendix B: SummitNet Map

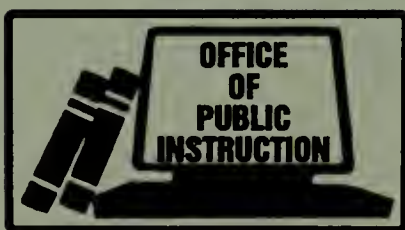




Appendix B: Data Collection

Appendix C: Technology Survey Data

DISTRICT INFORMATION				NUMBER OF ITEMS	
RESPONSE RATE	percent response	total response	percent response	total response	percent response
ELE DISTRICTS	69.3%	211	305	72.6%	76,384
HS DISTRICTS	65.0%	82	123	69.3%	29,424
K-12 DISTRICTS	76.2%	29	43	48.3%	7,931
TOTAL DISTRICTS	68.8%	322	471	69.3%	113,739
COOPS	34.8%	8	23		164,341
Overall - 69% response rate					
- RESPONSE NUMBER -					
- PROJECTED TO TOTAL -					
TYPE OF COMPUTERS	Total	Elem	HS	% total	Total
IBM	7,798	2,714	5,084	39%	11,251
MAC	5,482	3,381	2,101	28%	7,909
APPLE	6,308	4,189	2,119	32%	9,101
OTHER	271	183	88	1%	391
TOTAL	19,859	10,467	9,392	100%	28,652
Students per computer				5.7	7.7
COMPUTER LOCATION BY LEVEL					
Elementary Level	157	142	212	30	
Percent of Ele Districts	58.6%	65.7%	73.6%	69.8%	
Percent of Computers	34.8%	61.7%	66.4%	67.5%	52.7%
High School Level	111	74	76	13	
Percent of H S Districts	41.4%	34.3%	26.4%	30.2%	
Percent of Computers	65.2%	38.3%	33.6%	32.5%	
TOTAL	268	216	288	43	47.3%
DISTRICT USERS OF COMPUTERS					
ADMINISTRATORS USE	171	89	36	10	
% districts - admin	63.8%	41.2%	12.5%	23.3%	
TEACHERS USE	163	152	176	26	
% districts - teachers	60.8%	70.4%	61.1%	60.5%	
STUDENTS USE	170	156	214	34	
% districts - students	63.4%	72.2%	74.3%	79.1%	
LIBRARY USE	119	81	50	9	
% districts - library	44.4%	37.5%	17.4%	20.9%	
COMMUNITY USE	68	35	15	4	
% districts - community	25.4%	16.2%	5.2%	9.3%	
DISTRICT INFORMATION					
NUMBER NETWORKED COMPUTERS	5,384				7,768
DISTRICTS WITH TECHNOLOGY PLAN	72				104
DISTRICTS USE DISTANCE LEARNING	66				95
DISTRICT NETWORK ACCESS					
METNET	172				248
INTERNET	62				89
AMERICA ONLINE	34				49
COMPUERVE	13				19
PBS	110				159
CABLE	114				164
FIBER OPTIC	28				40
STAR SCHOOLS	15				22
OTHER	49				71
Ag Network	ITV				
Big Sky Telegraph (8)	MAE-FAIRS				
Channel 1	NMC/MSU				
Dialog (2)	Parmly Lib				
Ed TV	Prodigy (4)				
EduNet	Schol Net				
Exp Exchg	TCI				
IdeaNet (2)	Ti In				
SCHOOL DISTRICT					
OTHER TECHNOLOGY	RESPONSE				PROJECTED TOTALS
PRINTERS	8,093				11,677
FAX MACHINES	234				338
PROJECTION DEVICES	1,736				2,505
MODEMS	1,005				1,450
TELEVISIONS	2,847				4,108
SATELLITES	198				286
VCRs	2,382				3,437
LASER disk players	320				462
CD ROMs	1,569				2,264
VIDEO CAMERAS	581				838
TELEPHONES	3,648				5,263
	1,245				2,373



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